United States Department of Agriculture
Forest Service
Pacific Northwest Region

A Field Guide to

Important Forest Insects and Diseases of Oregon and Washington

A FIELD GUIDE TO IMPORTANT FOREST INSECTS AND DISEASES OF OREGON AND WASHINGTON

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Introduction

This field guide has been prepared to provide forest resource managers with a basic tool for quick field identification of common and destructive insects and diseases. It is limited to those insects and diseases causing serious problems to coniferous trees in Oregon and Washington. It should be used as a quick reference and guide to identifying pests described in the following two recent publications:

1. Furniss, R.L. and V.M. Carolin. 1977. Western Forest Insects. Misc. Pub. No. 1339, USDA Forest Service.
2. Bega, Robert V. 1978. Diseases of Pacific Coast Trees. Agriculture Handbook No. 521, USDA Forest Service.

Identifications made from this guide should be followed by a review and verification from one of the above books. It has been designed specifically for use in the field and only where serious problems are evident. Should it be used for any other purpose it will prove inadequate.

No attempt has been made to describe or even list all insects and diseases found on forest trees. A detailed key is provided for those insects and diseases that are commonly encountered in the forest and cause serious problems.

The identifying characters listed are those most easily recognized in the field and are primarily the damage caused by the insect or disease.

Certain insects and diseases are not included in this guide. Among these are:

- Heart rots and saprophytic fungi
- Insects and fungi affecting forest products
- Insects and diseases of cones, seeds, and seedlings
- Root and soil insects
- Non-pathogenic diseases caused by drought, sun scald, winter damage, mechanical damage and chemical (air pollution, chemical sprays) injury.

To use this guide start with the first couplet. Read both parts of the couplet and decide which best fits the situation at hand. Go to the number referred to and continue until the insect or disease has been identified. Under each insect or disease described is a reference to one of the above publications with the page number where the organism is described.

Following the key section of this guide are three additional sections that will provide an aid to the forest land manager identifying pest problems. The glossary of terms should be consulted when questions of vocabulary

arise. When insect or disease specimens are sent to specialists for identification, the sender should refer to the section on submitting insect and disease specimens. Following these few simple instructions will insure faster and better service. Also provided is a list of scientific names of insects and diseases and host species attacked which will be helpful when identifying those pests on unusual or rare hosts.

Key

1. Rapid tree decline and death with full needle complement; no visible distortion of or feeding on needles 2

   Slow tree decline; sparse foliage, discoloration of needles, needle feeding or mining, cankers, galls, top killing, or flagging 3

2. Beetle activity prominent under bark on main stem of tree as evidenced by egg galleries and/or larval galleries 24

   No bark beetles under bark, or if so, not prominent 35

3. Foliage chewed or mined 4

   Foliage not chewed or mined 20

4. Foliage webbed together 5

   Foliage not webbed together 10

5. Large masses of foliage webbed together or large webs in crotch of tree; larvae tend to be gregarious; most common on hardwoods . . . . . Webworms and tent caterpillars
   Misc. Pub. #1339, p. 216

   Small masses of foliage webbed together, often only new foliage at tips of branches or two or three needles 6

6. Caterpillars mining needles; two or three needles may be webbed together, host — all pines . . . . . Needle miners
   Misc. Pub. #1339, p. 177

   Caterpillars not mining needles; expanding foliage at tips of branches webbed together and fed on; seldom on pines (Larch budmoth webs foliage together but not at tips of branches) 7

7. On Western larch . . . . . Larch budmoth
   Misc. Pub. #1339, p. 166

   Not on western larch 8

8. On spruce . . . . . Spruce budmoth
   Misc. Pub. #1339, p. 166

   Not on spruce 9

9. Caterpillars brown with yellowish-green markings and with pale warty tubercles on sides . . . . . .Western spruce budworm
Misc. Pub. #1339, p. 168

Caterpillars green with black head . . . . . .
Western black-headed budworm
Misc. Pub. #1339, p. 163

10. On western larch only; caterpillars causing browning of needles, construct a light brown case of a hollowed needle from which they partially emerge to feed on needles; caterpillar and case less than ¼-inch long; active August-October, overwinter in cases on twigs; active May-June; damaged needles may be twisted or curled and soon fall . . . . . Larch casebearer
Misc. Pub. #1339, p. 174

On all trees, including western larch; caterpillars do not construct a case but may mine needles; larvae generally longer than ¼-inch 11

11. Caterpillars very hairy with brightly colored tuffs of hairs; two long brushes or pencils of black hair, suggesting horns, behind head and a single similar but longer brush of hair on the posterior end of the body; dense, light-brown or cream-colored toothbrush-like tufts of hairs on the first four abdominal segments; prefers Douglas-fir and true firs . . . . . Douglas-fir tussock moth
Misc. Pub. #1339, p. 224

Caterpillars not hairy, nearly naked or with only scattered, fine hairs 12

12. Caterpillars move with a looping action; i.e., false legs are found only on the last few body segments while the midportion of the body lacks false legs, causing it to loop upward at regular intervals as the caterpillar crawls (loopers) (fig. 1) 13

Caterpillars move without a looping action; false legs are present on midportion of body (fig. 2) 14

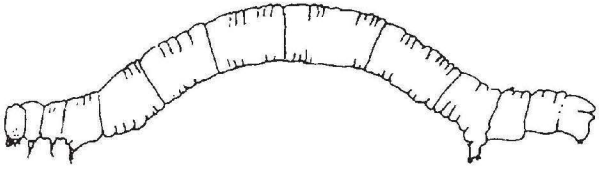

Figure 1 — Caterpillar with fleshy false legs absent from the mid-portion of the body. One pair of false legs is present on the posterior of the body.

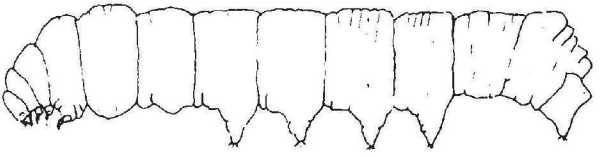

Figure 2 — Caterpillar with four pair of fleshy false legs present on the mid-portion of the body.

13. On western hemlock; newly hatched caterpillars (June to July) marked with transverse black and white bands; older caterpillars (July, August, and September) body color varies from yellow-green to brown, both head and body flecked with black; most often occurring in old-growth western hemlock stands in western Oregon and Washington; prefers western hemlock but will eat most other plants . . . . .
Western hemlock looper
Misc. Pub. #1339, p. 205

On all trees including western hemlock; body color not as described above . . . . . .
Other loopers
Misc. Pub. #1339, p. 199

14. Needle mining or needle sheath mining; on pines only 15

Needles chewed; larvae feeding externally on needles, not limited to pines 16

15. Caterpillars mining needles; 2 or 3 needles may be webbed together; hosts — all pines
Needle miners
Misc. Pub. #1339, p. 177

Caterpillars feeding and mining in needle sheaths; needles of new growth fading; fine silken webs around base of needle with small caterpillars feeding within the webbing; some needles may droop as a result of feeding at their base; preferred host is lodgepole pine . . . . . .
Pine needle-sheath miner
Misc. Pub. #1339, p. 142

16. Caterpillars with 6 or more pairs of false legs on mid-portion of body; feeding often limited to older needles; caterpillars often gregarious, especially when newly hatched (sawflies) (fig. 3) 18

Caterpillars with no more than 4 pairs of false legs on mid-portion of body; seldom gregarious; on pines only (fig. 2) 17

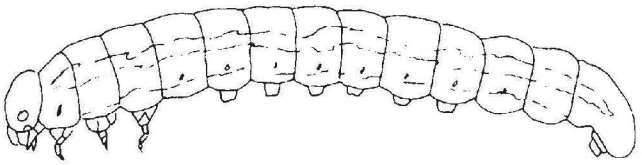

Figure 3 — Sawfly larvae with six pair of fleshy false legs on the mid-portion of the body.

17. Newly hatched caterpillars black or brown and covered with short, dark hairs; mature caterpillars yellowish-green or brown, 2½ to 3½ inches long . . . . . Pandora Moth
Misc. Pub. #1339, p. 193

Color green with two white stripes on each side; mature caterpillars 1 to 1¼ inch long; preferred host — ponderosa pine
Pine butterfly
Misc. Pub. #1339, p. 240

18. On western hemlock; mature caterpillars vary in color from yellow-green to dark gray with dark longitudinal stripes . . . . . .
Hemlock sawfly
Misc. Pub. #1339, p. 444

Not on western hemlock 19

19. On western larch; caterpillars gray-green along the back and whitish beneath . . . . . Larch sawfly
Misc. Pub. #1339, p. 450

On pines, true firs, and Douglas-fir . . . . . Other sawflies
Misc. Pub. #1339, p. 439

20. Trees with flagged branches or with dead or dying tops, top dying may include only the last one or two years growth or a much larger portion of the top 21

Tree with no flagged branches or top kill 35

21. Top killing in only the last one or two years growth; no flagged branches 22

Top killing includes more than the last one or two years growth, or tree with branch flagging 23

22. On Sitka spruce . . . . . Sitka spruce weevil
Misc. Pub. #1339, p. 332

On Douglas-fir or pines . . . . . Terminal miners
Misc. Pub. #1339, pp. 154, 181, and 146

23. Bark beetle galleries prominent under bark of dying top or branches; branches or tops die rapidly 24

No bark beetle galleries under bark of dying branches or tops; branches and tops generally die slowly, often with progressive dying back 35

24. Only larval feeding galleries present; galleries increase in size as larvae feed through cambium; galleries never straight, always winding and turning; up to ¾-inch wide (fig. 4) 25

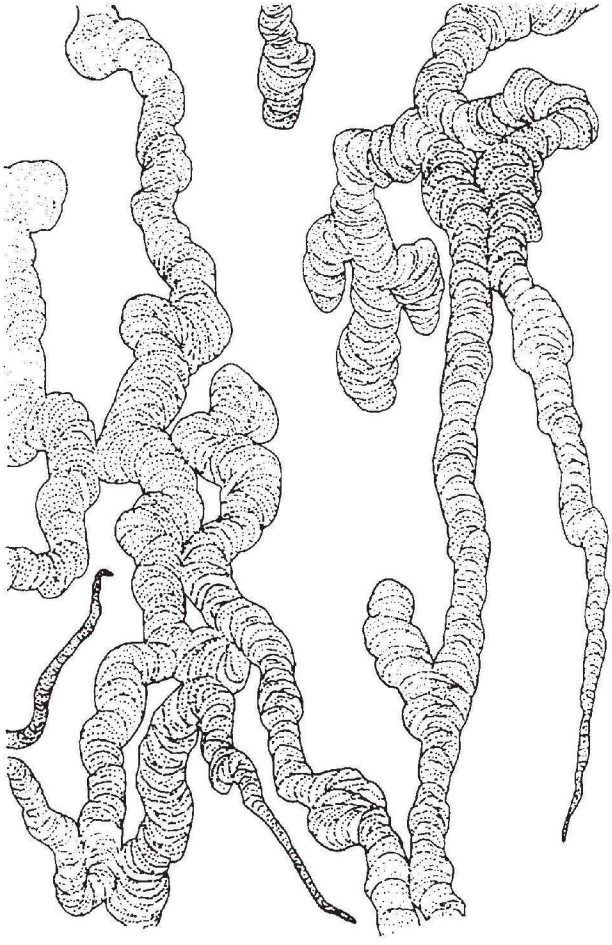

Figure 4 — Gallery pattern of the flatheaded borers. The gallery pattern of the roundheaded borers is similar in shape and size but lacks the concentric arc pattern in the boring frass.

Typical bark beetle gallery with both egg and larval galleries; egg gallery uniform in width, seldom more than ¼-inch wide (fig. 5) 26

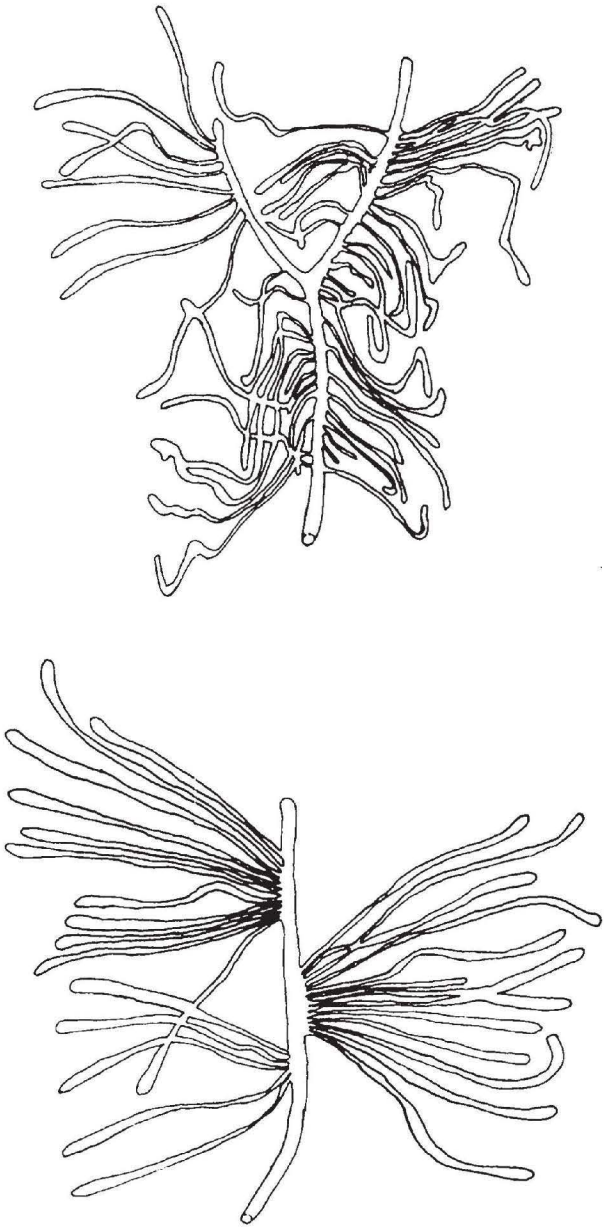

Figure 5 — Gallery patterns of bark beetles showing the central egg gallery with the larval galleries extending outward from the egg gallery.

25. Gallery tightly packed with fine boring frass; concentric arc pattern in boring frass
Flatheaded borers
Misc. Pub. #1339, p. 254

Gallery loosely packed with granular and or fibrous boring frass; concentric arc pattern not evident . . . . Roundheaded borers
Misc. Pub. #1339, p. 286

26. In pines 27

Not in pines 30

27. Larvae feeding together in a common brood chamber; individual larval galleries not made; generally limited to lower 6 feet of the tree; large pitch tubes up to 1½ inches in diameter form where beetles bore through bark (fig. 6) . . . . . .
Red turpentine beetle
Misc. Pub. #1339, p. 362

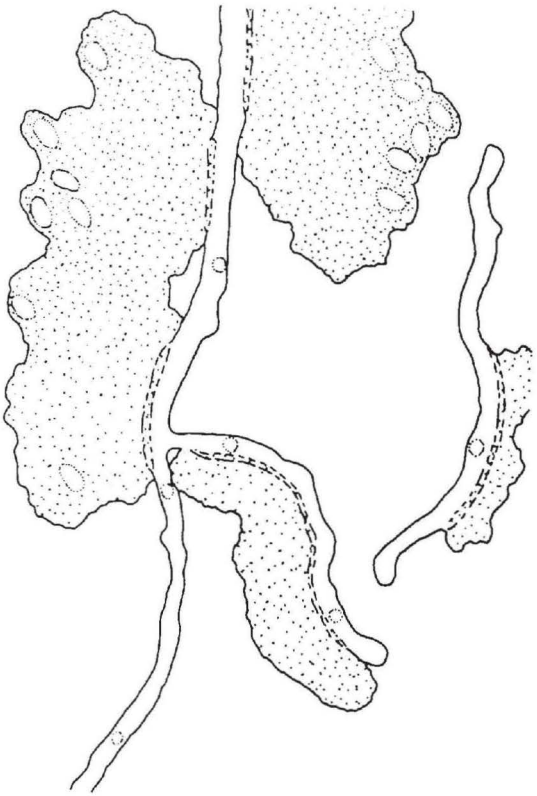

Figure 6 — Gallery pattern of the red turpentine beetle with the larvae feeding in common brood chambers.

Larvae feed individually, not in a common brood chamber; not limited to lower 6 feet of the tree; pitch tubes may be found but seldom over ¾-inches in diameter 28

28. Egg gallery packed with boring frass; generally quite long 29

Egg gallery not packed with boring frass; generally short, less than 6 inches; beetles with posterior of abdomen concave on upper surface; beetles prefer small trees and branches or tops of large trees; preferred host — ponderosa pine (fig. 7) . . . .
Pine engraver
Misc. Pub. #1339, p. 390

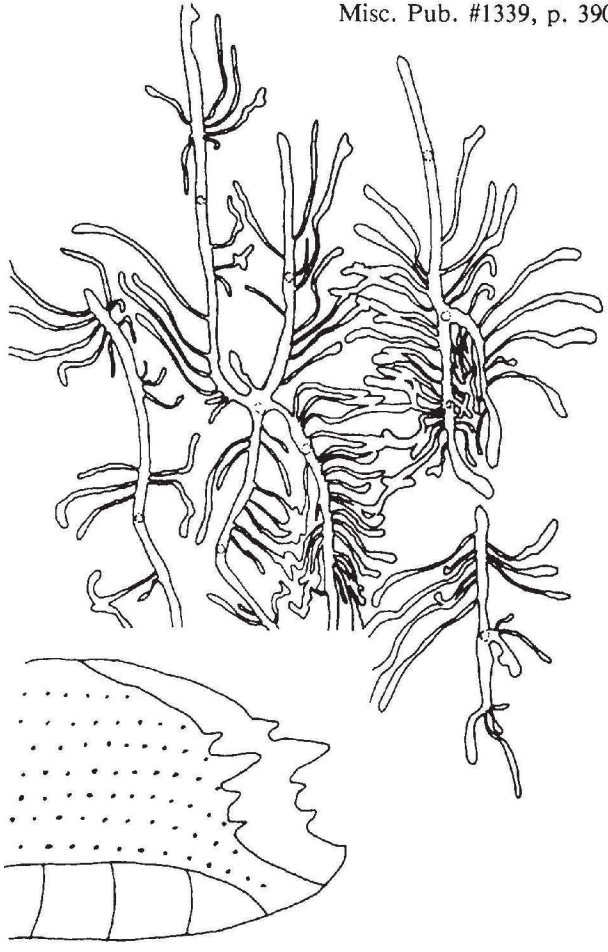

Figure 7 — Gallery pattern of the pine engraver. Insert shows the concave upper surface of the posterior of the abdomen.

29. Egg gallery not winding, generally straight and long; vertical to grain never crossing, larval galleries evident in cambium layer where larvae feed; host — all pines (fig. 8)
Mountain pine beetle
Misc. Pub. #1339, p. 353

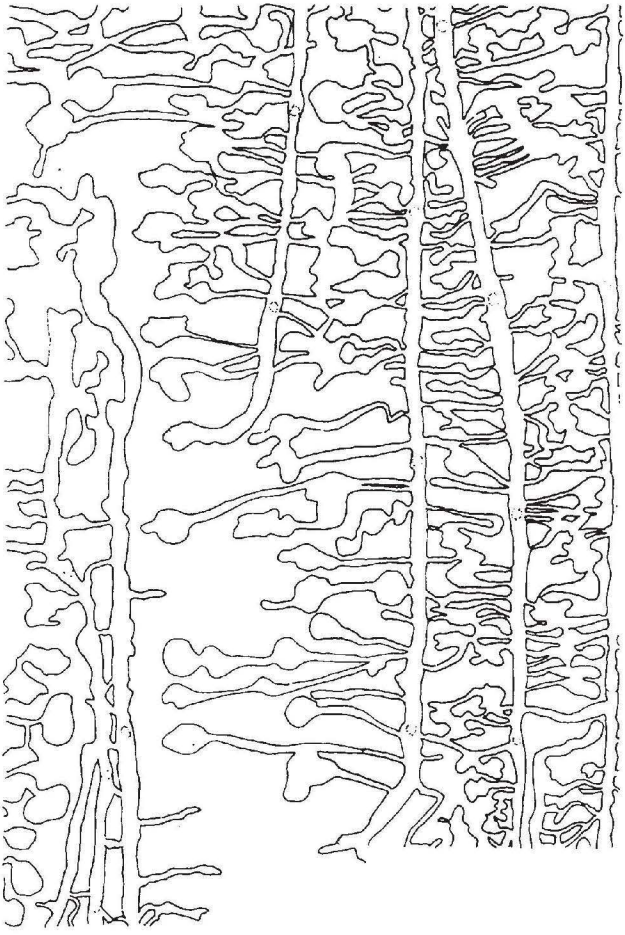

Figure 8 — Gallery pattern of the mountain pine beetle with the straight egg gallery and the larvae feeding in the cambium.

Egg gallery very winding with much crossing and recrossing; larval galleries evident for only a short distance outward from egg gallery before entering outer bark where larvae feed; host — sawlog and larger ponderosa pine (fig. 9) . . . . . .

Western pine beetle

Misc. Pub. #1339, p. 348

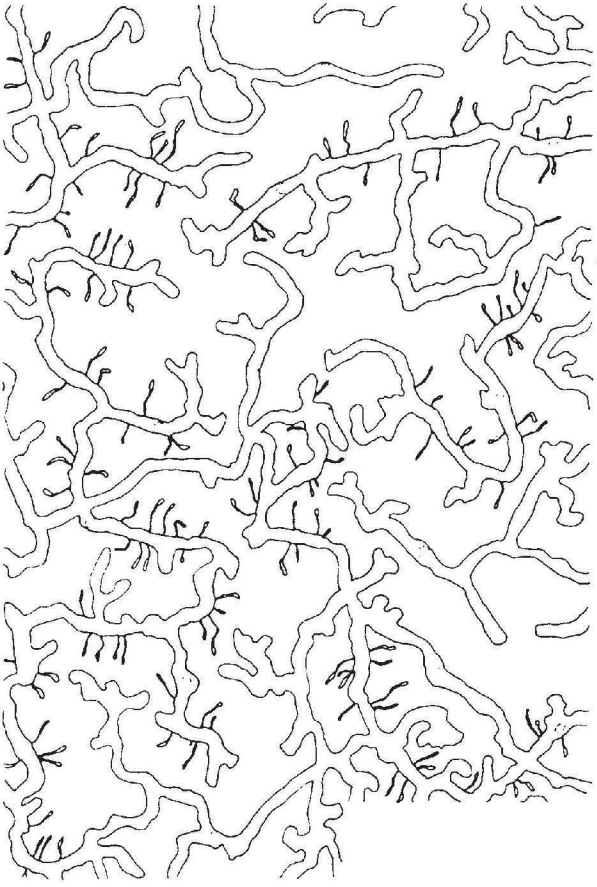

Figure 9 — Gallery pattern of the western pine beetle with the winding egg gallery and the larval galleries visible for only a short distance in the cambium.

30. In spruce, egg gallery vertical to grain, 4 to 6 inches long, less than ¼-inch wide (fig. 10) . . . . . Spruce beetle
Misc. Pub. #1339, p. 359

In Douglas-fir or true firs 31

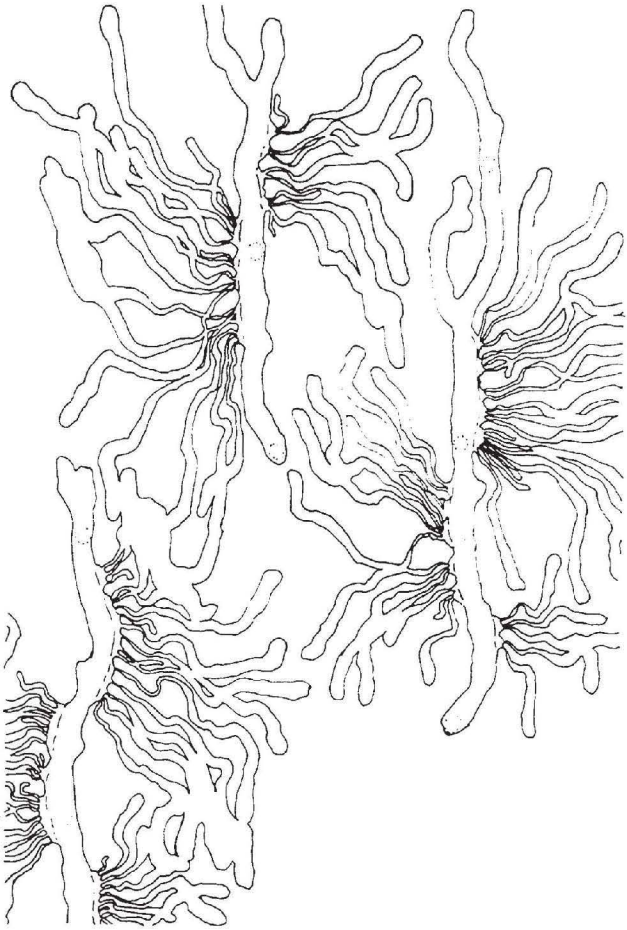

Figure 10 — Gallery pattern of the spruce beetle.

31. In Douglas-fir; egg gallery vertical to grain of wood 32

In true firs; egg gallery horizontal to grain of wood 34

32. In sawlog size trees; egg gallery about ¼-inch wide, packed with boring frass, 6 to 30 inches long; eggs laid in groups at intervals alternating along the sides of the egg gallery, resulting in larval galleries radiating outward from egg galleries in fan shapes; outward evidence of beetle attack is reddish-brown boring dust in bark crevices and on ground at base of tree (fig. 11) .

Douglas-fir beetle

Misc. Pub. #1339, p. 357

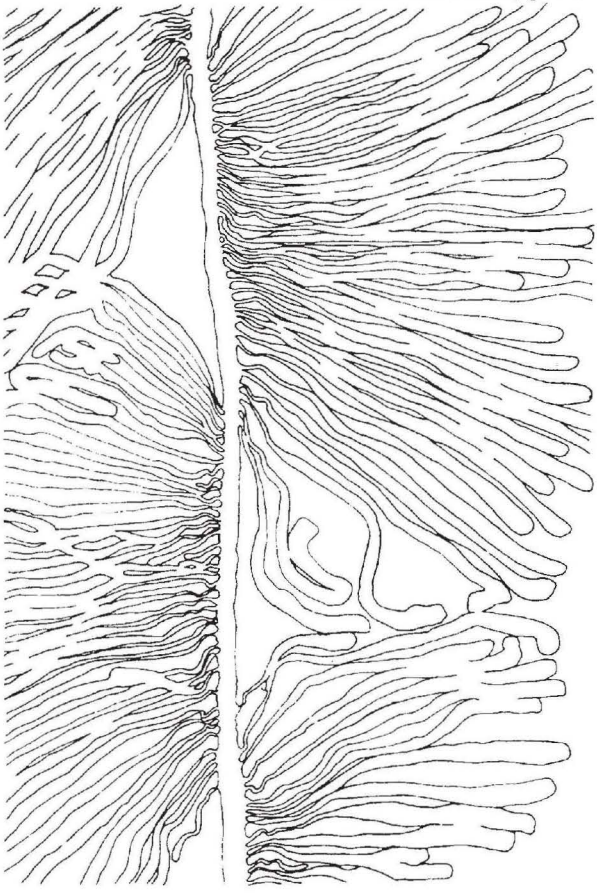

Figure 11 — Gallery pattern of the Douglas-fir beetle with the larval galleries radiating outward from the egg gallery in fan shapes.

In poles and saplings; egg gallery less than ¼-inch wide and less than 6 inches long; eggs laid singly on both sides of egg gallery (fig. 12) 38

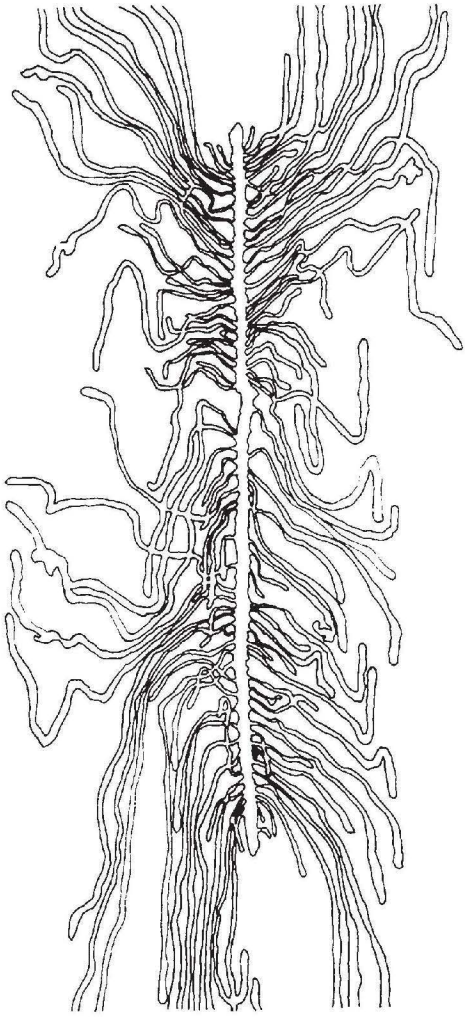

Figure 12 — Gallery pattern of a bark beetle in sapling or pole-size Douglas-fir. The larval galleries of this pattern do not radiate outward in fan shapes.

33. Beetles with posterior of abdomen concave on underside (fig. 13) . . . . . .

Misc. Pub. #1339, p. 408

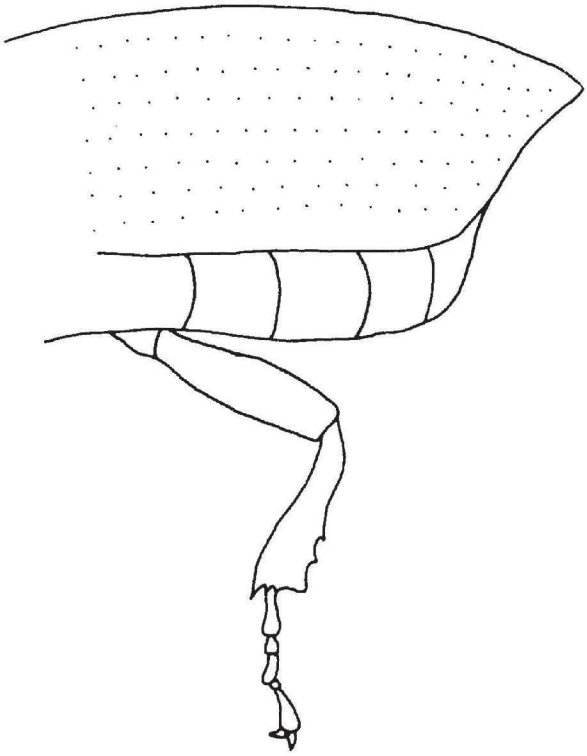

Figure 13 — Posterior end of a bark beetle with the abdomen concave on the underside.

Beetles with posterior of abdomen not concave (fig. 14) . . . . . Douglas-fir pole beetle
Misc. Pub. #1339, p. 372

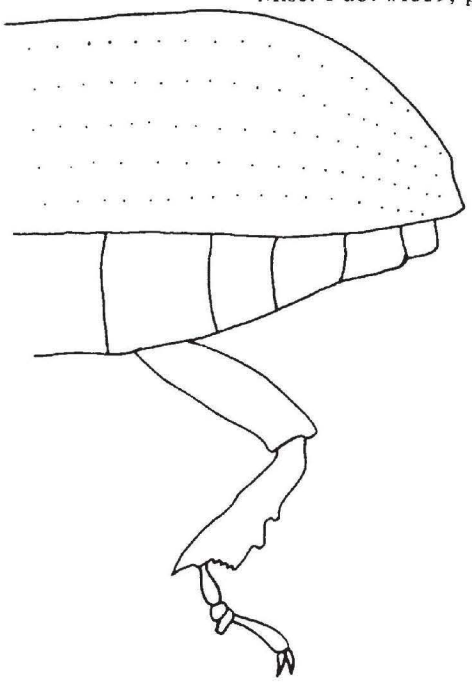

Figure 14 — Posterior end of a bark beetle with the abdomen not concave.

34. Egg gallery deeply scoring sapwood (fig. 15); beetles with posterior of abdomen concave on underside (fig. 13); beetles shiny black; preferred hosts — grand fir and subalpine fir . . . . . **Fir engraver**
Misc. Pub. #1339, p. 409

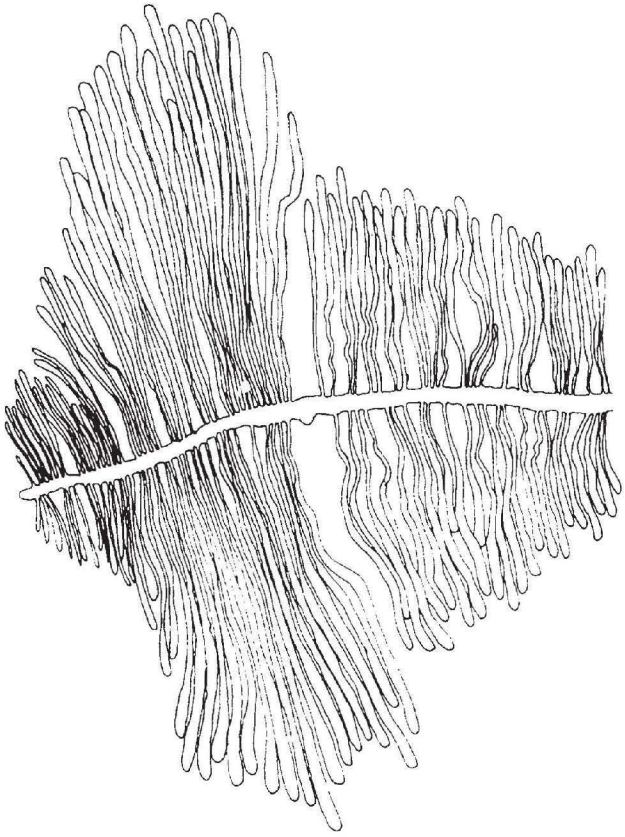

Figure 15 — Gallery pattern of the fir engraver.

Egg gallery only lightly scoring sapwood or not at all (fig. 16); beetles with abdomen not concave (fig. 14); preferred host — Pacific silver fir . . . . . Silver fir beetles or Fir root bark beetle
Misc. Pub. #1339, p. 371

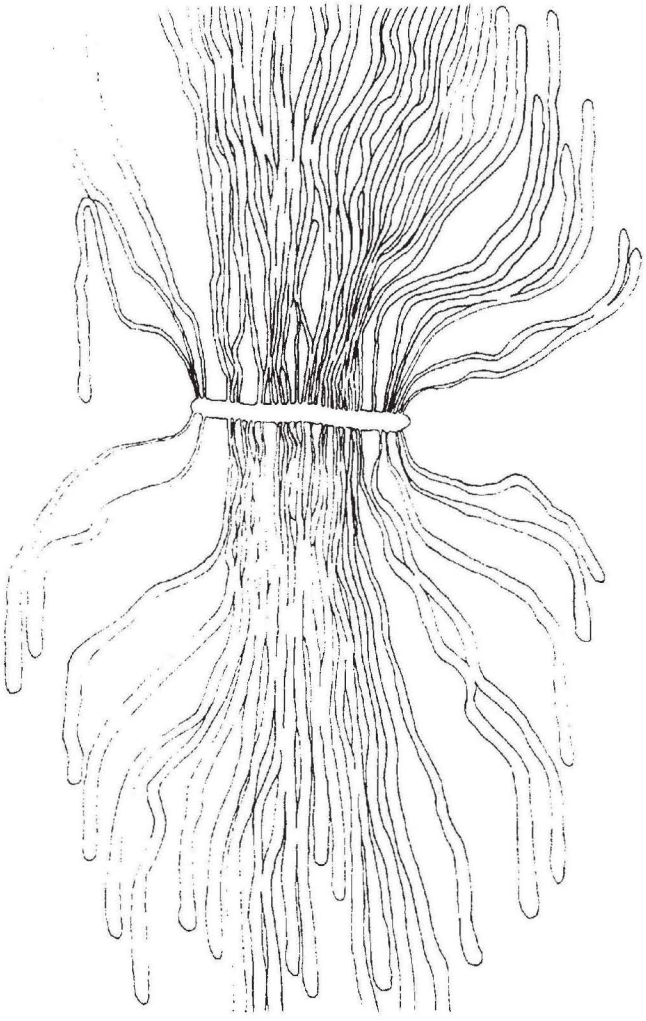

Figure 16 — Gallery pattern of the silver fir beetle.

35. Galls, swellings, or cankers on main stem or branches; never on foliage 36

No galls, swellings, or cankers, or if present, only on needles 43

36. Galls or swellings on tips of branches of true fir and spruces, terminal bud almost always involved in gall or swelling 37

Galls, swellings, or cankers never at tips of branches 38

37. On true firs only; small galls or swellings (generally ½-inch or less in diameter) on tips of branches and sometimes at branch internodes . . . . . .Balsam woolly aphid
Misc. Pub. #1339, p. 107

On spruce only; cone-like galls on tips of branches; galls light green to dark purple in spring, turnirg brown in summer, 1 to 2 inches long . . . . . Cooley spruce gall aphid
Misc. Pub. #1339, p. 103

38. Spindle-shaped swellings on branches, often with yellowish-green plants 1 to 8 inches long growing from swellings; on all species of trees . . . . . Dwarf mistletoes
Handbook #521, p. 127

Galls or cankers on branches or main stem; cankers may be spindle-shaped, galls never spindle-shaped or with plants growing from them; on pines only 39

39. Globose galls, varying in size from ½-inch to several inches in diameter on branches and up to 1 foot in diameter on main stem . . . . . Western gall rust
Handbook #521, p. 103

Cankers on main stem and branches 40

40. Cankers on western white, sugar, and other 5-needle pines; often cankers girdle main stem or branches; canker margins greenish-yellow; white to orange blisters may be present on bark within cankered area . . . . . .White pine blister rust
Handbook #521, p. 94

Cankers on lodgepole or ponderosa pine . . 41

41. Wood beneath canker stained grayish-green to bluish-black . . . . . Atropellis Canker
Handbook #521, p. 72

Wood beneath canker not stained 42

42. On lodgepole pine . . . . . Stalactiform rust
Handbook #521, p. 98

On ponderosa pine . . . . . Comandra rust
Handbook #521, p. 107

43. Witches'-brooms in the crown of the tree . . 44

No witches'-brooms 46

44. Witches'-brooms accompanied by spindle-shaped swellings on branches, often with yellowish-green plants 1 to 8 inches long growing from swellings; brooms may be very large but generally not tightly compacted; can be found on most tree species . Dwarf mistletoes
Handbook #521, p. 127

Witches' brooms not accompanied by spindle-shaped swellings or plants; brooms often tightly compacted and ball-shaped; on ponderosa pine and true firs 45

45. On ponderosa pine; needle fading or reddening may accompany witches'-brooms; branches often curled upwards; brown mottled flecks in cambium of older infected twigs . . . . . Elytroderma needle cast
Handbook #521, p. 55

On true firs; witches'-brooms ball-shaped and tightly compacted; needle fading common . . . . . Fir broom rust
Handbook #521, p. 105

46. Large pitch tubes on main trunk and larger branches 47

No pitch tubes 48

47. Pitch tubes limited to lower 6 feet of trunk; on pines only; bark beetle activity in cambium layer (fig. 6) . . . . . Red turpentine beetle
Misc. Pub. #1339, p. 362

Pitch tubes not limited to base of tree, over entire trunk and large branches; on pines and Douglas-fir . . . . . Pitch moths
Misc. Pub. #1339, p. 138

48. Pin-head to pea-size cottony tufts on bark or needles; never on pines (fig. 17) 49

No cottony tufts on bark or needles 51

49. On bark of true firs only; cottony tufts pin-head size or smaller; may be so numerous to make bole of tree appear whitish-gray; tips of twigs often gouted or swollen, often to the point of enclosing terminal bud; distribution limited to west of Cascade Mountains . . . . . Balsam woolly aphid
Misc. Pub. #1339, p. 107

On needles of western hemlock or Douglas fir (fig. 17A) 50

50. On western hemlock . . . Hemlock woolly aphid
Misc. Pub. #1339, p. 107

On Douglas-fir . . . . . Cooley spruce gall aphid
Misc. Pub. #1339, p. 103

51. Affected trees often in groups or patches containing trees that have been dead or affected for different periods of time; resin or gum exudation on roots or in root collar area often infiltrating soil to form a compact mass around roots or root collar; white to brown mycelium on bark surface or under bark of roots or root collar; trees of cone-bearing age may have a distress crop of cones; trees with thin or off-color foliage; rapid death usually limited to sapling or smaller size trees; large trees easily windthrown with roots of down trees often broken transversely near base of tree 52

Affected trees generally not in patches; no mycelium or resin exudation on roots or root collar; trees not easily windthrown . 56

52. Whitish to purple brown mycelial growth on outer bark surface of roots and root collar; rot laminated (separating along annual rings), pitted, with reddish, whiskery setal hyphae; affected trees often windthrown. Most susceptible hosts are Douglas-firs, true firs, and mountain hemlock .....
Laminated root rot
Handbook #521, p. 57

Mycelial growth absent or not on bark surface; rot not laminated with pits and setal hyphae 53

53. White fan-shaped mycelial mats under bark; black shoestring-like structures (rhizomorphs) may be found growing along infected roots and out into soil; heavy resin flow at root collar common; decay soft, spongy, yellowish, often stringy, and marked with numerous zone lines. All trees are hosts ..... Armillaria root rot
Handbook #521, p. 147

Lacking white mycelial mats under bark, rhizomorphs, and spongy, yellow decay 54

54. Resinosis in roots and root collar; decay soft, spongy and white with black flecks; occasionally small button or bracket shaped fruiting bodies in hollows or on roots under duff layer; trees may be windthrown or show substantial butt rot. Major hosts true firs and hemlocks .....
Annosus root rot
Handbook #521, p. 144

Lacking resinosis, spongy white decay with black flecks, or obvious fruiting bodies 55

55. Affecting Port-Orford-cedar; brown stain in roots and root collar; rapid tree decline; foliage turns red and tree dies .....
Port-Orford-cedar root rot
Handbook #521, p. 155

Affecting mostly Douglas-fir; dark brown to purple black stain in sapwood of roots and butts ..... Black stain root disease
Handbook #521, p. 150

56. On western larch 57

Not on western larch 58

57. Caterpillars causing browning of needles construct a light brown case of a hollowed needle from which they partially emerge to feed on needles; caterpillar and case less than ¼-inch long; active August-September, over-winter in cases on twigs, active in May-June; damaged needles may be curled or twisted and soon fall . . . . . Larch casebearer
Misc. Pub. #1339, p. 174

Needles not mined by insects; fungus fruiting bodies appearing as little black dots, which sometimes merge into short rows on upper surface of needles; affected needles tend to remain on tree, sometimes through winter . . . . . Hypodermella needle cast

58. On spruce 59

Not on spruce 61

59. Cone-like galls on tips of branches; galls light green to dark purple in spring, turning brown in summer; 1 to 2 inches long; remainder of tree normal . . . . . Cooley spruce gall aphid
Misc. Pub. #1339, p. 103

No galls on branches; needles may be sparse or off-color 60

60. Old needles sparse; new needles at tips of branches unaffected; February to March greenish aphids can be found feeding on needles; a common pest of ornamental spruce . . . . . Spruce aphid
Misc. Pub. #1339, p. 96

All needles fading or with blotchy appearance; most common in late summer after warm dry weather; fine silk webbing may cover needles; shaking of branches over a white paper will reveal very small spider-like insects; a common pest of ornamental spruce . . . . . Spider mites
Misc. Pub. #1339, p. 60

61. On pines 62

Not on pines 66

62. Scale insects on needles (fig. 17B); common where dust or smoke is found in the atmosphere 63

No scale insects on needles 64

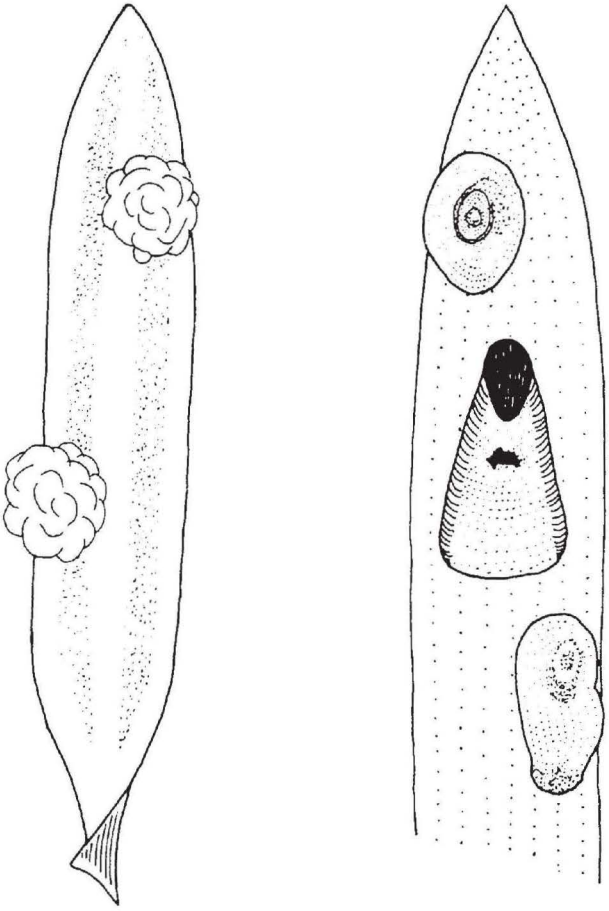

Figure 17 — A, cottony tufts on a needle.
B, scale insects on a pine needle.

63. Scales yellowish-brown to black; oblong to round; about 1/16-inch in diameter . . . **Black pine leaf scale**
Misc. Pub. #1339, p. 117

Scales whitish, elongated and up to 1/8-inch long . . . . . **Pine needle scale**
Misc. Pub. #1339, p. 115

64. Needles of new growth fading; fine silken webbing around base of needles with small caterpillars in webbing feeding on base of needles; some needles may droop because of feeding at their base; preferred host — lodgepole pine . . . . . Pine needle-sheath miner
Misc. Pub. #1339, p. 142

Needles of previous seasons growth fading; no webbing on base of needles, if webbing is present, it will bind 2 or 3 needles together their entire length 65

65. Caterpillars mining in needles . . Needle miners
Misc. Pub. #1339, p. 177

No mining of needles . Elytroderma needle cast
Handbook #521, p. 55

66. On Douglas-fir and true firs; needles fading, turning brown and rusty causing trees to look as if fire-scorched; needles covered with a silvery webbing; very small spider-like insects on needles; best seen with a hand lens; not a common pest . . . Spider mites
Misc. Pub. #1339, p. 60

On Douglas-fir only; no silk webbing on needles; needles may be off-color, blotchy or with swellings 67

67. Gall-like swellings on needles; needles may be bent at point of swelling; discoloration around swelling may be yellow, orange, or purple; severely damaged needles may drop during winter, lightly damaged needles may remain on tree for 1 or 2 additional seasons (fig. 18) . . . . . Douglas-fir needle gall midge Misc. Pub. #1339, p. 417

No gall-like swellings on needles 68

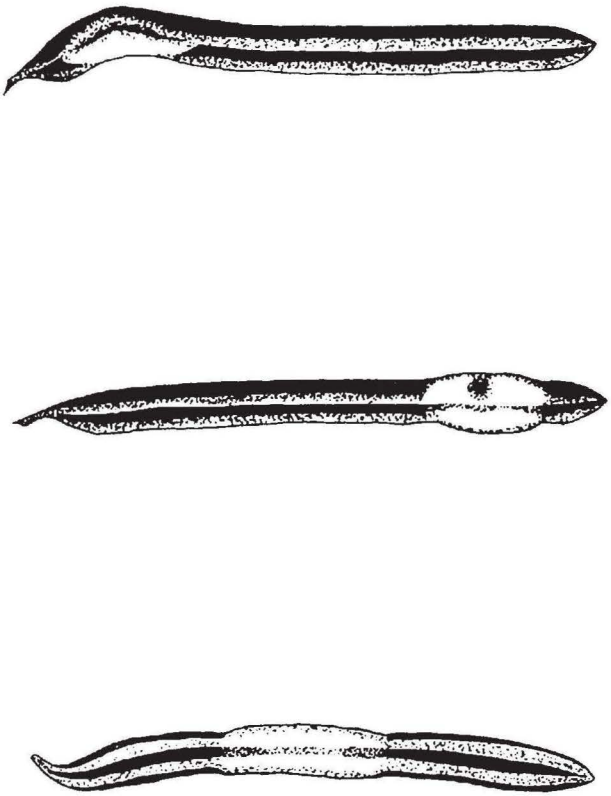

Figure 18 — Gall-like swellings on the needles of Douglas-fir caused by Douglas-fir needle gall midge.

68 Tiny white scale insects or black, minute, crawling insects on needles; may be so numerous that foliage appears to be sprinkled with pepper; heavy feeding causes mottled yellowish appearance to needles; needles may be distorted or bent

Cooley spruce gall aphid
Misc. Pub. #1339, p. 103

No scale or crawling insects on needles; fall to early spring needles with slightly yellow-colored spots, most frequent near the ends; by spring yellow spots have turned to reddish-brown; during June, reddish-brown to orange fruiting bodies appear on underside to needles, with affected needles starting to fall; not on current year's needles . . . . . Rhabdocline needle cast
Handbook #521, p. 50

Glossary

Abdomen — The third or posterior division of the insect body; contains no legs in the adult stage, but often has false legs or fleshy outgrowths in the larval stage.

Abdominal segment — The ring-like subdivisions of the abdomen.

Adult — A full-grown, sexually mature insect; usually with wings as contrasted to the larva which never has wings.

Boring dust — Reddish-brown, pulverized bark excavated by the adult bark beetle as it bores through the outer bark; often collects in small piles in bark crevices and around base of tree.

Boring frass — The waste product of insect borings found within the galleries; composed of insect excrement and finely chewed bark and wood.

Brood chamber — The cavity in the cambium layer in which immature insects feed and develop.

Canker — A definite, relatively localized necrotic lesion of the bark and cambium. Some swelling may be present.

Cottony tufts — The wool-like wax secretions covering some of the sucking insects.

Egg gallery — A passage, burrow, or mine made by the adult bark beetle in the cambium layer for the purpose of egg laying.

False legs — A soft leg-like abdominal appendage that serves the purpose of a leg; especially the fleshy, unjointed abdominal legs of caterpillars and certain sawfly larvae; i.e., proleg; pseudopod.

Flag — (Flagged branches) A dying or recently dead leafy twig or branch which contrasts in color with the normal green color of the living tree.

Fruiting body — Any fungal structure which contains or bears spores.

Gall — An abnormal growth of plant tissue, stimulated by insect or fungal activity.

Gregarious — Caterpillars tending to remain in groups.

Larval gallery — A passage, burrow, or mine made by the larva of bark beetles as it feeds through the cambium layer; always filled with boring frass.

Mature caterpillar — A full-grown larva; one that will grow no larger in size before transforming to the pupa.

Mycelium — The thread-like or mat-like vegetative parts of fungi.

Needle feeding — External feeding on needles; portions or all of needle may be consumed.

Needle mining — Larvae of insects feeding wholly within the needle, with the only external evidence of feeding being a small entrance hole and sometimes an exit hole.

Needle sheath — The tubular envelope binding the base of needles together.

Pitch tube — A tubular mass of reddish-brown to cream-colored resin mixed with bark, wood borings and insect excrement that forms on the surface of the bark at bark beetle entrance holes; ¼ to 1½ inches in diameter.

Root collar — The transition zone between trunk and root, at or about soil level.

Scale insects — Sedentary insects, with a waxy or scale-like covering, not cottony.

Tubercle — A small, knoblike or rounded protuberance.

Webbing — Silken threads spun by the larvae of certain insects, usually around partially eaten foliage.

Witches'-brooms — A compact, bushy growth of twigs or branches of the tree, markedly different from that resulting from normal growth of the tree and characterized by the shortening of the internodes and excessive multiplication of branches.

Submitting Insect and Disease Specimens for Identification

Insects or diseases that cannot be identified in the field or those for which a positive identification is needed should be submitted to specialists for identification.

When collecting and shipping specimens the following procedures should be followed.

A. Collecting the specimen
   1. Provide adequate material
      a. Collect whole plant if size permits; e.g., seedlings.
      b. Include both healthy and injured plant tissue.
      c. Collect enough damaged material to allow for the possibility of shipping damage and to provide for various laboratory tests.
   2. Provide adequate information
      a. Where specimen was collected (be as specific as possible) even include elevation if known).
      b. When specimen was collected.
      c. Who collected the specimen.
      d. Description of host (age, species, general appearance).
      e. If known, give history of any treatments (chemical, logging, thinning, etc.), construction activities, natural catastrophes (fires, blowdown, etc.) that have occurred in the area.
      f. Try to identify the problem. The field man's opinion can be very helpful to laboratory identification.
      g. If appropriate use USDA Forest Service Form 5200-1(3/78).

B. Preparing specimens for shipment
   1. General
      a. Use plastic bags when material is not excessively wet or soggy. Any material subject to mold or deterioration should not be shipped in plastic bags.
      b. Prepare specimens so breakage in shipping will be minimal — broken and crumbled specimens are often difficult to identify.

2. Insects
   a. Soft-bodied insects, such as larvae, should be preserved and shipped in isopropyl alcohol. A screw-top vial or bottle is best to prevent leakage during shipment.
   b. Pupae and hard-bodied insects can be shipped in small (pill) boxes. Place them between layers of tissue paper to prevent breakage in shipping. Do not pack insects in cotton.
   c. Adult moths, butterflies, and fragile insects should be folded between paper before packing in the tissue paper.
3. Needle disease
   a. Do not ship in plastic bags.
   b. Sprinkle lightly with water before wrapping in newspaper.

C. Shipping
1. Ship promptly - fresh specimens are easiest to identify. If specimens can't be shipped as soon as arriving from the field, they should be stored in a refrigerator.
2. Include address inside of shipping carton.
3. Mark "SPECIMEN ENCLOSED" in large letters on the outside of the carton.
4. Check regulations concerning shipment of live material in order to prevent unintentional violations of law.
5. Resource managers of Federal forest lands in Oregon and Washington should send specimens for identification to:

   United States Forest Service
   Forest Pest Management
   P.O. Box 3623
   Portland, Oregon 97208

   Resource managers of non-federal forest lands in Washington should send specimens to the Washington State Department of Natural Resources in Olympia.

   In Oregon, specimens should be sent to the State Department of Forestry in Salem.

Summary of Scientific Names and Hosts

Common Name[1]	Scientific Name	Common Hosts[2]	Occasional or Rare Hosts[2]
Atropellis canker (D)	**Atropellis spp.**	LP	P
Balsam wooly aphid (I)	**Adelges piceae**	TF	
Western black-headed budworm	**Acleris gloverana**	WH,TF,DF	S
Black pine leaf scale (I)	**Nuculaspis californicus**	PP,LP	P,DF
Black stain root disease (D)	**Verticicladiella wagenerii**	P,DF	
Comandra rust (D)	**Cronartium comandrae**	PP,LP	
Cooley spruce gall aphid (I)	**Adelges cooleyi**	DF,S	
Douglas-fir beetle (I)	**Dendroctonus pseudotsugae**	DF	WH,WL
Douglas-fir engraver (I)	**Scolytus unispinosus**	DF	
Douglas-fir pole beetle	**Pseudohylesinus nebulosus**	DF	
Douglas-fir needle gall midge (I)	**Contarinia spp.**	DF	
Doublas-fir tussock moth (I)	**Orgyia pseudotsugae**	DF,TF	PP
Dwarf mistletoe (D)	**Arceuthobium spp.**	A	
Elytroderma needle cast (D)	**Elytroderma deformans**	PP	LP
Fir broom rust (D)	**Melampsorella caryophyllacearum**	TF	
Fir engraver (I)	**Scolytus ventralis**	TF	
Fir root bark beetle (I)	**Pseudohulesinus granulatus**	TF	
Flatheaded borers (I)	**Family Buprestidae**	A	
Hemlock woolly aphid	**Adelges tsugae**	WH	
Hypodermella needle cast (D)	**Hypodermella laricis**	WL	
Larch budmoth (I)	**Zieraphera improbana**	WL	TF
Larch casebearer (I)	**Coleophora laricella**	WL	
Loopers (I)	**Family Geometridae**	A	
Western hemlock looper (I)	**Lambdina fiscellaria lugubrosa**	WH	A
Mountain pine beetle (I)	**Dendroctonus ponderosae**	P	
Needle miners (I)	**Coleotechnites sp.**	PP, LP	A
Pine butterfly (I)	**Neophasia menapia**	PP	WH, LP, DF, WP, WL
Pandora moth (I)	**Coloradia pandora**	PP, LP	
Pine engraver (I)	**Ips pini**	PP	P, S
Pine needle scale (I)	**Chionaspis pinifoliae**	P	DF
Pine needle-sheath miner (I)	**Zelleria hambachi**	PP, LP	
Pitch moths (I)	**Vespamima spp.**	PP, DF	LP, WL
Port-Orford-cedar root rot (D)	**Phytophthora lateralis**	PC	
Red turpentine beetle (I)	**Dendroctonus valens**	PP, LP	WL, S, DF, TF
Rhabdocline needle cast (D)	**Rhabdocline pseudotsugae**	DF	
Root rots (D)			
Armillaria (D)	**Armillaria mellea**	A	
Laminated root rot (D)	**Phellinus weirii**	A	
Annosus rot (D)	**Fomes annosus**	A	
Roundheaded borers (I)	**Family Cerambycidae**	A	
Sawflies (I)		A	
Hemlock sawfly (I)	**Neodiprion tsugae**	WH	
Larch sawfly (I)	**Pristiphora erichsonii**	WL	
Silver fir beetles (I)	**Pseudohylesinus sericeus**	TF	
Sitka spruce weevil (I)	**Pissodes strobi**	SS	
Spider mites (I)	**Family Tetranychidae**	A	
Spruce aphid (I)	**Elatobium abietinum**	S	

Summary of Scientific Names and Hosts

Common Name[1]	Scientific Name	Common Hosts[2]	Occasional or Rare Hosts[2]
Spruce beetle (I)	**Dendroctonus rufipennis**	ES	S, LP
Spruce budmoth (I)	**Zieraphera spp.**	S	
Stalactiform rust (I)	**Cronartium stalactiforme**	LP	PP
Tent caterpillars (I)	**Family Lasiocampidae**	A	
Terminal miners (I)			
European pine shoot moth (I)	**Rhyacionia buoliana**	P	
Ponderosa pine tip moth (I)	**Rhyacionia zozana**	PP	P
Western pine shoot borer (I)	**Eucosma sonomana**	PP, LP	
Webworms (I)	**Family Arctiidae**	A	
Western gall rust (D)	**Endocronartium harknessii**	LP, PP	
Western pine beetle (I)	**Dendroctonus brevicomis**	PP	P
Western spruce budworm (I)	**Choristoneura occidentalis**	TF, DF	WH, WL, S
White pine blister rust (D)	**Cronartium ribicola**	5P	

1) (I), Insects; (D), Diseases

2) A, all trees; P, all pines; LP, lodgepole pine; PP, ponderosa pine; 5P, 5-needle pines; TF, true firs; DF, Douglas-fir; WH, western hemlock; S, all spruces; SS, sitka spruce; ES, Engelmann spruce; WL, western larch; ES, Engelmann spruce; WL, western larch; PC, Port-Orford-cedar